

# Energy

# Teacher's Introduction to Energy

## Energy Use in Kentucky Increases 81% since 1960

Energy production and consumption have increased steadily in the United States and in Kentucky during the last several decades. The total amount of energy used in Kentucky by businesses, industry, homes, and for other purposes has risen 81% since 1960.

Kentucky produces significant amounts of non-renewable energy resources including coal, natural gas, and crude oil. We also have the potential to produce great quantities of renewable fuels such as ethanol from grain, wood, and solar power.

Experts estimate that 25% of the energy we use is wasted due to overconsumption and inefficiency. And the production and use of fossil fuels for energy has resulted in many of the world's and our state's most complex environmental problems including global warming, acid rain, and water and air pollution. The magnitude of these problems and their predicted impact on human and ecological health have sparked a new awareness of the need to conserve energy and make wise energy choices.

New federal laws such as the Energy Policy Act of 1992 and the Clean Air Act Amendments of 1990 focus much needed attention on many of these problems. Many experts are encouraging the public and private sectors to reduce energy consumption, improve efficiency, and develop and use less polluting and non-polluting renewable resources. It is important to look closer at how we can conserve energy, not only to preserve our energy resources, but to save money as well.

Of all the things we can do for the environment, conserving energy can have the greatest impact. The following activities will offer your students a chance to review trends in energy consumption and production in Kentucky and devise strategies for reducing energy use in their homes and school.

## v Where to Get Information

The "State of Kentucky's Environment" report contains information regarding energy consumption and production trends for our state, conservation needs, a discussion of energy strategies and more. The Air Quality chapter also covers the environmental impacts of burning fossil fuels for energy. Check the index in the report for general information and the expanded index in the Appendix of this guide to find a list of all the references to your county and region.

## ⌘ Overview of Student Activities

### Activity 1: Our Increasing Demand for Energy

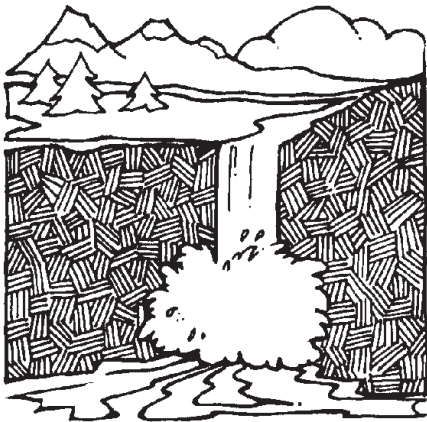
This activity will enable students to view trends in the use and production of coal, natural gas, and petroleum as well as renewable energy sources such as solar and hydroelectric in Kentucky. They will also explore energy resources used in the home and in transportation and look at how our energy resources may change in the future.

### Activity 2: Energy and the Environment

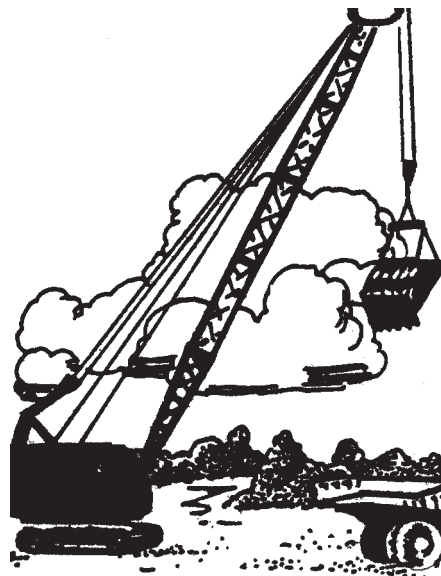
This research project focuses on the importance of energy conservation and how we can all play a part in lowering our energy costs while reducing environmental pollution. Student teams will investigate the role our cars play in contributing to global warming. They will also identify how the purchase of fuel efficient cars can reduce pollution and save money.



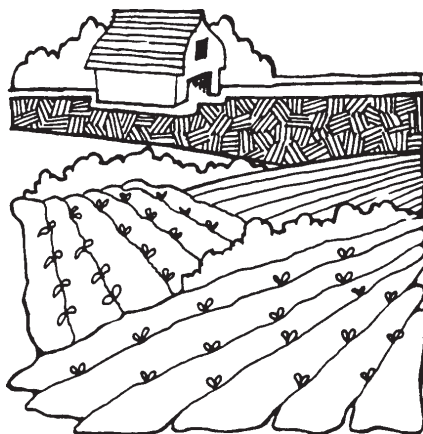
Solar Energy



Hydropower



Fossil Fuels



Biomass

# Activity 1. Our Increasing Demand for Energy

## Instruction Sheet

### DO YOU KNOW...

- 🔧 How much more energy you use in your home today compared to the amount the average person used in 1960?
- 🔧 How much of the energy you use is probably wasted?
- 🔧 How energy production and consumption impact environmental quality?

### Energy Demand and Production Increasing In Kentucky

*High school students from across Jefferson County got a taste of what the cars of tomorrow may be like. About a dozen, home-made, solar powered toy cars, designed by the student teams, competed in hot-rod races on the Belvedere.*

*Each team was given a solar panel and engine. Then they glued and tapped and wired together almost every possible combination of soft drink bottles, metal, cardboard, wood, styrofoam, and prayers. The victorious chariot was constructed by Justin Tamplin, Chip Frazier, Hon Helton and Ben Koby from Kentucky Country Day School.*

*How did it work? According to Chip, the sun heats the solar panel, which acts like a battery and provides electric current that turns the motor, which turns the gears, which turns the axle, which turns the wheels. Students also built other projects with their solar panels including a solar emergency distress transmitter, a portable power pack that could run a radio and a fan at the beach, a solar powered weed trimmer, and even a chicken coop cooled by solar energy. (Excerpted with permission from Rays-Car Fever, Solar-Powered Hot Rods Test Student Inventors, By Leslie Scanlon - Courier-Journal 5/12/93.)*

Kentucky has the potential to produce considerable amounts of energy from renewable resources such as wood, grains used to make ethanol fuel, hydropower, and solar power. But, today, almost all the energy we produce and consume comes from non-renewable sources such as coal and petroleum. These nonrenewable resources contribute greatly to our energy needs and economy, but also impact the environment when extracted and burned as fuel.

It is important to understand trends in energy use, in light of its environmental impact, so we can be better equipped to make wise choices in the type and amount of energy we use.

### 🔧 Purpose:

This activity will enable you to identify trends in the production and use of various energy sources including coal, natural gas, petroleum, and non-renewable energy sources used in our homes and businesses. You will also explore energy sources used in your school.

### 🔧 Procedure:

#### Part I - Learning More About the Energy We Consume and Produce in Kentucky

1. Obtain Worksheet #1 and #2 from your teacher. Review, discuss, and answer questions.

#### Part II - Energy Use in Your School

1. Divide into groups. List the various uses of energy in your school such as lighting, heat, etc. Be sure you consider all energy uses. For example, it takes energy to run the pump that delivers water to your school.
2. Investigate what type of energy source is used to power all the uses on your list.
3. Compare the energy sources used in your school to the statewide trends discussed in Worksheet #1 and #2.
4. Prepare a summary of your group's findings and present them to class.
5. As a class discuss ways your school can reduce its energy use.

#### Part III - Conducting a School Energy Audit

1. Conduct a simple energy audit of your school to identify areas where energy use can be reduced. Contact the Kentucky Division of Energy, 691 Teton Trail, Frankfort, KY, 1-800-282-0868, to receive more information about how to conduct a school energy audit.

## Instructions continued

### Part III - Going A Step Further

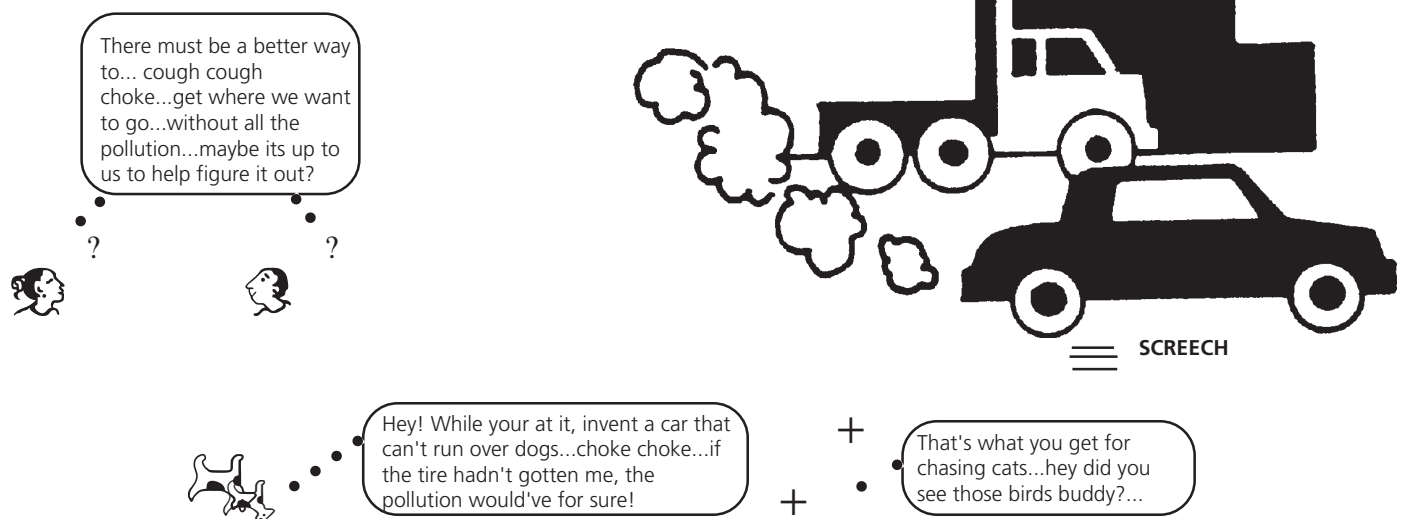
1. Submit the findings of your energy audit to the school principal. Request that the school adopt an energy conservation policy. Your school can also conduct a more in-depth energy audit and receive funding to do this through the Institutional Conservation Program. Contact the Kentucky Division of Energy, 1-800-282-0868 for more information about the program.

### Other Activities:

1. Investigate your local power plant. How many people does it serve? How much coal is used? What is the cost to produce this energy? How does the utility encourage energy conservation?
2. Investigate why the Kentucky Public Service Commission sets rates for electric and other utilities. Review how rates are determined and how you might become more active in this process.
3. Invite a representative from the electric company to class to discuss how energy is produced and delivered to your home and what the energy resources of the future will be.
4. Visit a power plant or an oil and gas well drilling operation.
5. Research the federal Energy Policy Act of 1992 and its affects in Kentucky.

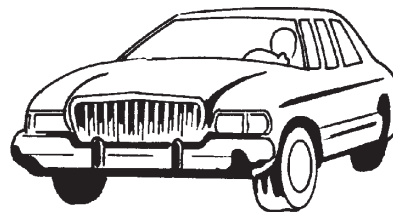
### References/Additional Resources:

1. Kentucky Division of Energy, 691 Teton Trail, Frankfort, KY 40601, 1-800-282-0868 can provide you with additional information on energy resources in Kentucky.
2. The Kentucky Department of Mines and Minerals, P. O. Box 14080, 3572 Iron Works Pike, Lexington, KY 40512-4080, 606-254-0367, can provide you with information on oil and gas drilling in your county.
3. The Public Service Commission, 730 Schenkel Lane, P.O. Box 615, Frankfort, KY 40602, 502-564-7246, regulates electric rates in Kentucky.



# Activity 1. Our Increasing Demand For Energy

## Worksheet #1: *Energy Consumption*

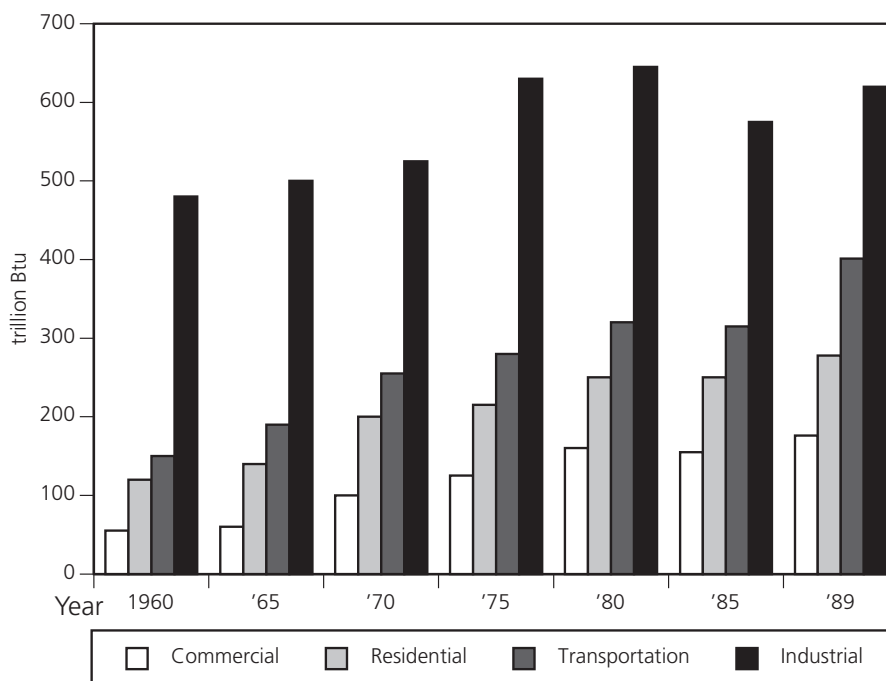


### Energy: A Resource Taken For Granted

Imagine waking up tomorrow morning in a world without energy. That would mean doing without electricity to power your blow dryer, refrigerator, television, lights, and having no running water since energy is needed to power a water pump. It was really not very many years ago when this was the way a typical day began. Our ancestors used candles, heated with wood, and rode horses to get around. In fact your grandparents probably remember when this was the case.

But times have changed. New and more modern technologies now allow us to receive the benefits of energy. And most of the time we take this for granted. Kentuckians are using more energy then ever before. Home, business, and industrial energy use has steadily increased during the last three decades. Total state energy use rose significantly between 1960 and 1989 (Figure 1). Kentucky is presently ranked nineteenth in the nation for energy consumption.

Figure 1  
**Total Energy Use in Kentucky**



Note: 1989 data most recent available.

Source: U.S. Department of Energy, EIA State Energy Data Report, 1991

## Worksheet #1 continued

Most energy consumed in Kentucky is used by industries. In 1989, industries used 387 trillion Btu of energy. Btu stands for "British thermal unit" and is equal to the amount of heat needed to raise the temperature of a gallon of water one degree Fahrenheit. Individual households are also using more energy per person than ever before, increasing greatly since 1960 (Figure 2).

The use of electricity in our homes has increased considerably since 1965. During 1965, 100.4 trillion Btu of energy were consumed for use in the home, compared to 146.8 trillion Btu in 1989 (Figure 3). This trend can be attributed to increased population, greater availability of electricity, and new electrical technologies and conveniences such as stereos, televisions, and appliances. During 1989, 1.6 million homes, businesses, and industries in Kentucky were served by electricity, an increase of 500,000 since 1970.

The use of gasoline, road oil, jet fuel, kerosene, and other petroleum to fuel our transportation needs also continues to increase in Kentucky. While the average Kentuckian traveled 9,127 car miles in 1989 compared to 6,201 miles in 1970, personal consumption of gas has remained fairly constant (Figure 4). This can be explained by the greater fuel efficiency of automobiles which has off-set the increase in miles traveled.

Kentuckians are also using millions more gallons of fuel for transportation than we did 30 years ago. We have become a mobile society and our demand for petroleum and other fuels continues to grow (Figure 5).

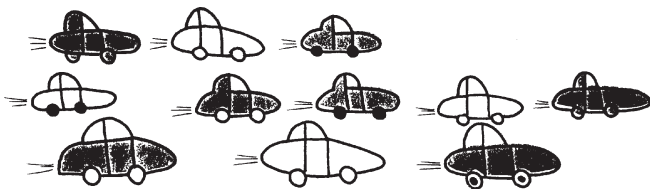
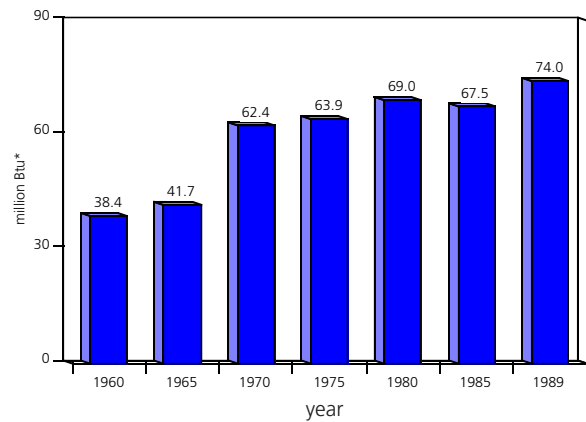
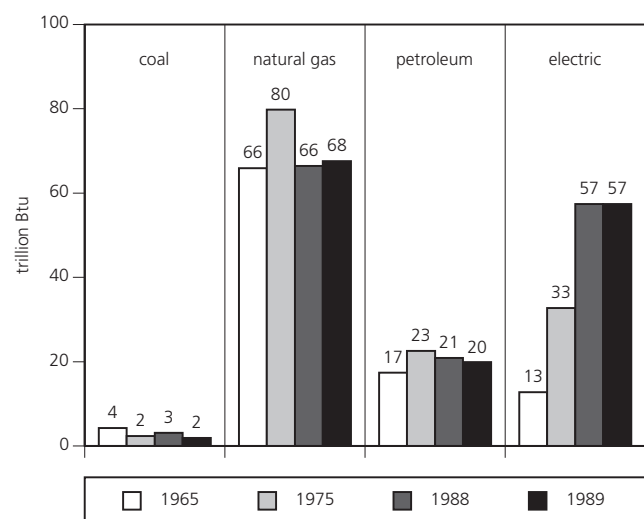


Figure 2  
**Energy Use Per Person in Kentucky Homes**



\*Includes coal, natural gas, petroleum, electricity—excludes solar, wood, other biomass.  
Note: 1989 data most recent available.  
Source: U.S. Department of Energy, EIA State Energy Data Report, 1991

Figure 3  
**Energy Sources Used In Kentucky Homes**

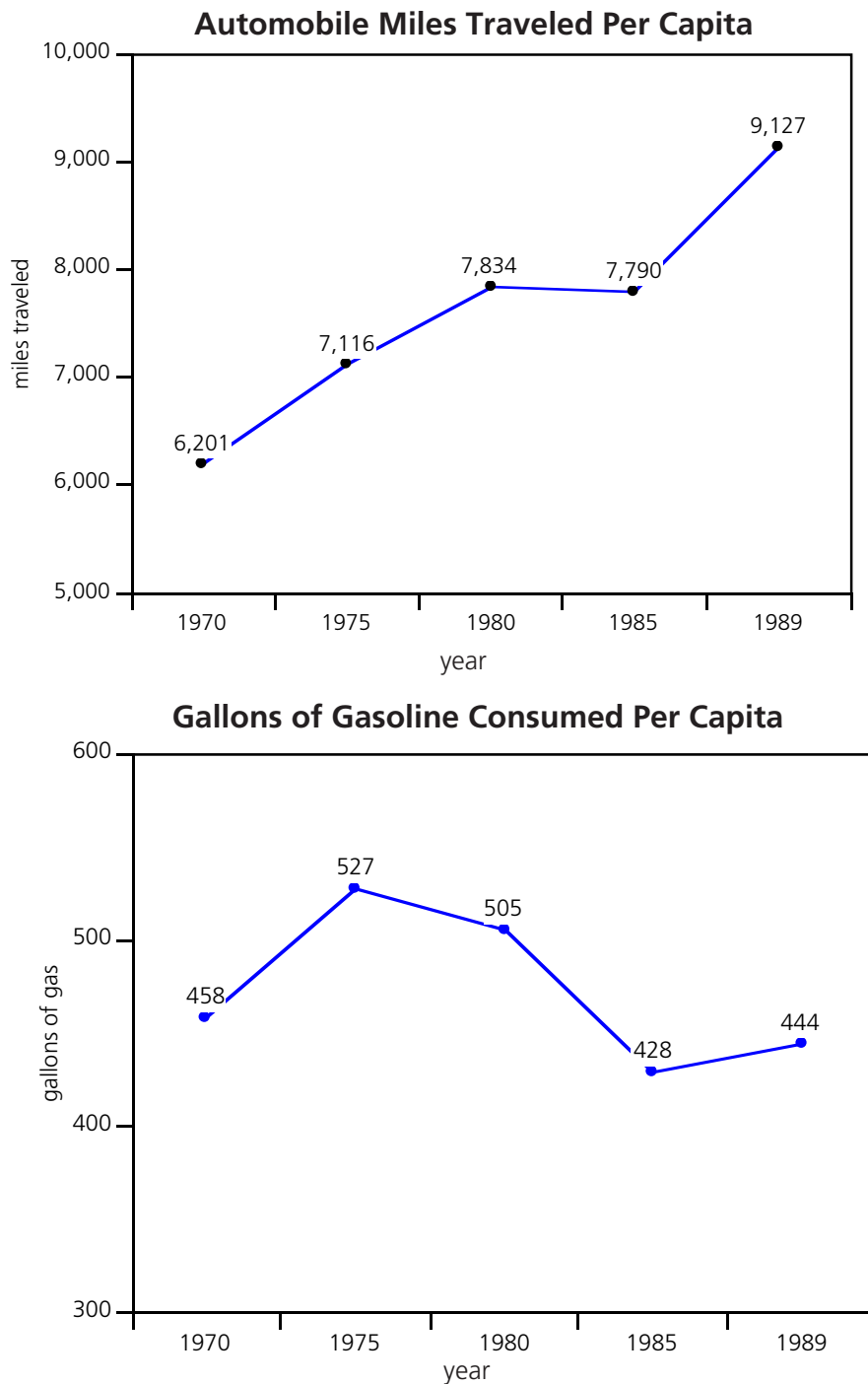


Note: 1989 data most recent available.  
Source: U.S. Department of Energy, EIA State Energy Data Report, 1991

## Worksheet #1 continued

Figure 4

### Personal Travel and Gasoline Use in Kentucky



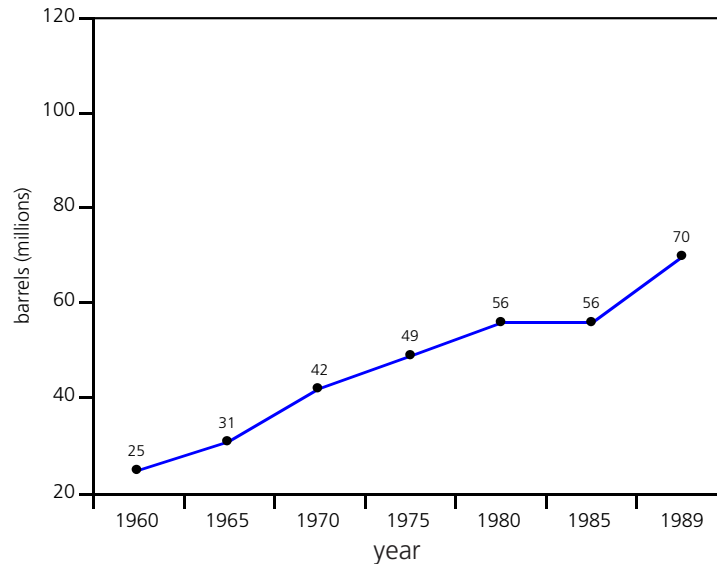
Note: 1989 data most recent available.

Source: U.S. Department of Energy, EIA State Energy Data Report, 1991; Kentucky Department of Transportation, 1991



**Worksheet #1 continued**

Figure 5

**Use of Petroleum Fuels\* for Transportation in Kentucky**

\* Includes: motor gasoline, road oil, jet fuel, distillate fuel, aviation gasoline, kerosene, LPG, lubricants, residual fuel, and miscellaneous fuels.

Note: 1989 data most recent available.

Source: U.S. Department of Energy, EIA State Energy Data Report, 1991

**QUESTIONS ?**

1. Calculate the percent change between 1960 and 1989 for commercial, residential, transportation, and industrial users? Which user had the greatest change? Which had the least change? Suggest some reasons for these changes.
2. Kentuckians now travel more miles than ever before but consume less gas. Calculate how many miles the average car got per gallon of gas during 1970 and 1989 using Figure 4.
3. How much did petroleum use increase in Kentucky between the years 1960 and 1989? Based on this trend, calculate how much petroleum we will be using in the year 2000.
4. Using the rate of increase in the amount of energy used for residential purposes between 1965 and 1989, estimate how much energy the average person will consume 24 years from today.
5. List the goods and services that you depend upon that are made possible by electricity and petroleum. Beside each item, note whether or not each use is a necessity or a luxury. Rank the items in order of importance in your life.

**WHAT YOU CAN DO...**

1. Tune up your car's engine regularly. You will get better gas mileage and reduce polluting emissions.
2. Improperly inflated tires can lower your gas mileage by 5%. Inflate tires to maximum pressure listed on sidewall - usually 30-35 pounds per square inch.
3. Turn off lights, the television, and other appliances when they are not in use. An estimated 25% of the energy we use is wasted due to overconsumption and inefficiency.

# Activity 1. Our Increasing Demand For Energy

## Worksheet #2: *Energy Production*

### State Ranks Among Top in Nation in Coal Production

The United States is the greatest energy consumer in the world, possessing large amounts of fossil fuel supplies to meet our growing demand. During 1990, non-renewable fossil fuels supplied 83% of the nation's energy demand.

The burning of coal for electricity is one of the energy sources greatly used in the United States. The nation's coal supplies are estimated at 180 billion tons, almost one-quarter of the world's total supply. More than half of this supply-about 105 billion tons- is located in Kentucky. Not all of this coal, however, can be mined due to various reasons.

Kentucky continues to mine large quantities of coal in both Eastern and Western Kentucky. Coal production reached a record high of 179 million tons in 1990, ranking the state second in the nation for coal production (Figure 1). This increase reflects a continuing demand for electricity as well as expanding markets for coal overseas. Nearly 80% of the coal produced in the state is used by the nation's power plant industry to generate electricity.

Additional measures to control the air pollutants created by burning coal at power plants are required under the federal Clean Air Act Amendments passed by Congress in 1990. These restrictions may have an impact on the future mining of coal, especially in the Western Kentucky, where the coal is higher in sulfur content. High sulfur coal, when burned, emits sulfur dioxide a pollutant associated with the formation of acid rain. But new pollution technologies such as "scrubbers" are being used at power plants to remove these pollutants. Also, new methods to clean the coal before it is burned, called "clean coal technologies," hold great promise in reducing the environmental impact from the burning of coal and maintaining a market for Kentucky coal.

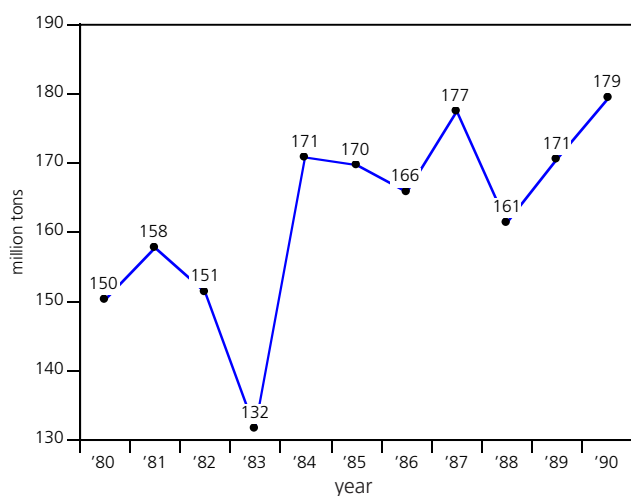
### 30,000 Oil and Gas Wells Operating in the State

There are an estimated 25 million barrels of petroleum reserves deep within geological formations in Kentucky. This is less than 1% of the nation's 27 billion barrels of oil reserves.

Oil drilling has been ongoing in the state since 1819. Since then, oil wells have been drilled in more than half of the state's 120 counties. Oil production currently occurs in 43 counties, but ten - Henderson, Union, Lee, Muhlenberg, Daviess, Hopkins, Clinton, Perry, Letcher, and Leslie - account for 70% of all oil produced in the state (Figure 2). Most of Kentucky's 20,000 active oil wells are "stripper" wells which produce less than ten barrels of oil per day (Figure 3).

Natural gas reserves are also present in Kentucky and are estimated to be nearly 940 billion cubic feet. Natural gas production occurs in 33 counties. However, 12 counties account for 92% of the natural gas produced in the state. They are, in order of production: Pike, Floyd, Knott, Martin, Perry, Leslie, Whitley, Letcher, Clay, Knox, Johnson, and Breathitt. There are approximately 10,000 active gas wells operating in the state.

Figure 1  
**Annual Coal Production in Kentucky**



Source: Kentucky Department of Mines and Minerals;  
Governor's Office for Coal and Energy Policy, 1991

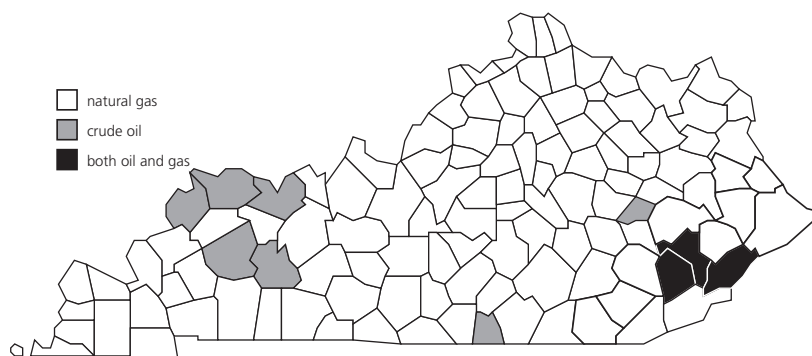
## Worksheet #2 continued

Natural gas production in Kentucky declined dramatically during the 1970s, increased through the 1980s, and has remained steady at about 73 trillion cubic feet since then (Figure 4). Although Kentucky produced enough natural gas to meet almost 40% of the state's demand, about 90% of natural gas consumed here actually came from other states. Gas is transported through the state by 61 pumping stations and many smaller pipeline systems. Natural gas produced in Kentucky, in turn, is transported via pipeline for consumption elsewhere.



Figure 2

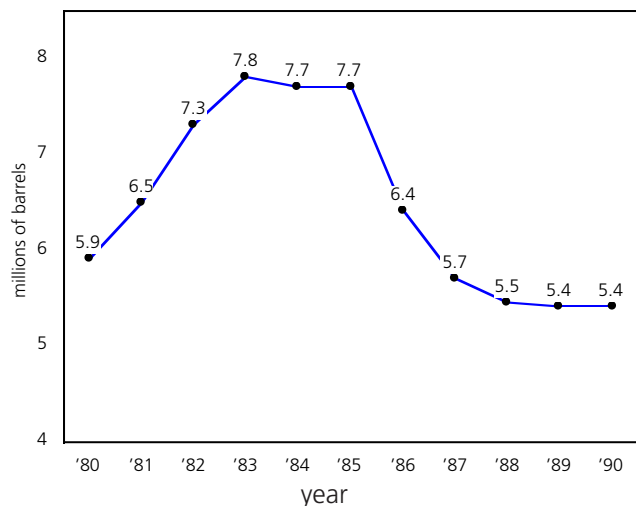
### Leading Oil and Gas Producing Counties in Kentucky



Source: Kentucky Department of Revenue, 1991

Figure 3

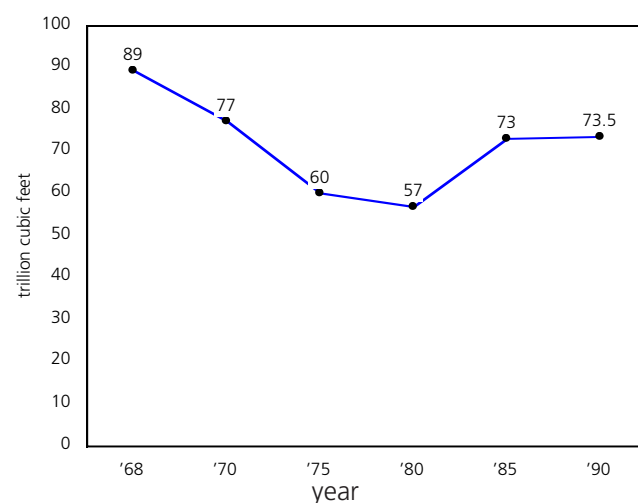
### Crude Oil Production in Kentucky



Source: U. S. Department of Energy, EIA State Energy Data Report, 1991

Figure 4

### Natural Gas Production in Kentucky



Source: U. S. Department of Energy, EIA State Energy Data Report, 1991

## Oil Shale May be Energy Source of the Future

What will be Kentucky's energy resources of the future? Many hope we will improve technologies to harness the energy of the sun and water because they are non-polluting sources that are readily available. Others believe nuclear energy is the appropriate choice, but opponents contend nuclear energy is too dangerous and technologies have not been developed to safely dispose the high-level radioactive waste created. Converting coal into a liquid is called "coal liquefaction." This technique is receiving increased interest as a future energy source and as a means to help the nation achieve its goal of reducing dependence on foreign energy sources.

## Worksheet #2 continued

A fossil fuel that has received some interest is tar sand. Kentucky has 4 billion barrels of oil found in tar sands. The Kentucky Institute of Mines and Mineral Research indicates that there are about 28.9 billion barrels of oil shale reserves in 15 counties. Oil shale has not been tapped as an energy source due to economic and technological difficulties associated with converting it to a usable resource.

### Renewable Energy Use Growing in Kentucky

Renewable resources such as wood, hydroelectric, wind, and solar power currently meet 4% of U.S. energy demands. Recent events in Iraq and Kuwait have revived interest in renewable fuels as a supplement to meet the nation's energy needs. With aggressive research and development, renewable resources could supply 28% of the nation's energy needs by the year 2030, according to the U.S. Assistant Secretary of Energy.

Kentucky possesses great quantities of renewable fuels. Forests in the state represent an estimated renewable energy reserve of 136 trillion Btu. Cutting wood for energy peaked during the late 1940s when wood was used in industrial boilers and for home heating (Figure 5). The increased availability of electricity, coal, and petroleum resulted in the decreasing use of wood for fuel. During 1973, the removal of trees from Kentucky forests for fuel began increasing again due to the oil embargo and higher fuel prices. Approximately 300,000 cords of wood were harvested for fuel in 1987, the highest level since 1974.

About 10% of the nation's electricity is generated by hydroelectric plants. These plants generate electricity by converting the energy of running water. Kentucky has seven hydroelectric plants located on six waterways.

In 1989, these plants produced 45 trillion Btu of electric power, about 6% of the electricity consumed in the state. Energy produced by these facilities has fluctuated over the years due to stream flow conditions. Hydroelectric production rates in 1989, however, were at their highest level in the state since 1965.

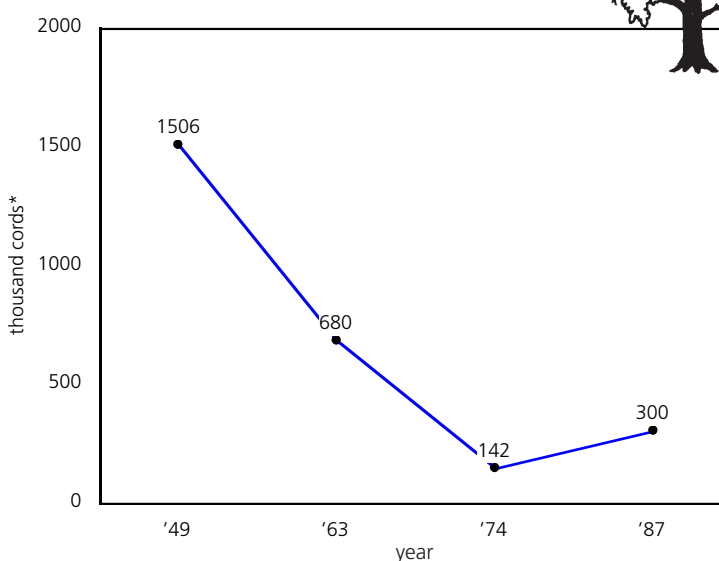
### Passive Solar Power Can Cut Energy Costs

Solar power, another renewable energy source, can be converted to electricity or used directly for heat. Solar collection and heating systems are used throughout the state, but it is not known how much of this energy is produced or consumed.

National data show that the use of solar energy steadily increased during the 1970s. During the last ten years, interest in solar energy has declined due to falling oil prices. The federal government's solar energy budget went from a high of \$600 million during President Carter's Administration to a low of \$70 million in President Reagan's Administration. Interest in solar energy is again increasing due to higher fuel costs. The federal budget allotted \$100 million in 1991 to solar energy research and has increased that amount to \$146 million in 1992.

Figure 5

### Annual Removal of Trees for Fuelwood in Kentucky



\* A standard cord of firewood is equal to 80 cubic feet of wood or 3 logs 18" in diameter and 16' long.

Note: 1987 data most recent available.

Source: U. S. Forest Service Surveys 1953, 1960, 1970, 1988

## Worksheet #2 continued

The Kentucky Division of Energy (KDE) is actively promoting the use of solar energy by educating homebuilders and the public about techniques that can be used to harness power from the sun which do not require expensive investments. This may include the placement of windows in certain areas to help warm or cool your home. Producing solar energy from active solar devices such as panels, however, is more limited in Kentucky due to the state's topography and cloud conditions.

### Use of Grain-Based Ethanol Fuels in Kentucky above National Average

Agricultural products, particularly grain, can be used to produce a renewable fuel known as ethanol. Ethanol is mixed with nine parts gasoline and sold as "gasohol," a motor vehicle fuel. It takes about one bushel of corn to make 2.5 gallons of ethanol. This extends gasoline while reducing air pollution from motor vehicles. National ethanol production increased significantly during the last decade from 20 million gallons in 1979, to 825 million gallons in 1989.

Several Kentucky gasoline suppliers sell ethanol fuel blends. In 1990, 19% of the gasoline consumed in the state was gasohol. In comparison, the amount of gas containing ethanol consumed nationally was about 6% in 1990.

### QUESTIONS?

1. List the nonrenewable energy resources produced in Kentucky. Why do you think these resources are called nonrenewable?
2. List the renewable energy resources produced in Kentucky. Why you think these sources are referred to as renewable?
2. Calculate the percent change in Kentucky's coal production for the years 1980 and 1990. Why do you think the production of coal has increased? Do you think this trend will continue? Explain your answer.
3. What year did oil production peak in Kentucky? What percentage has it declined since then?
4. What do you think will be the energy sources of the future? Explain your answer.

### WHAT YOU CAN DO...

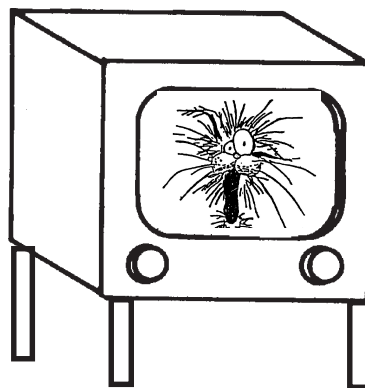
1. In the average American home, the water heater is the second largest energy user. To conserve energy, adjust the temperature on your water heater to 120 degrees (dishwashers without their own heaters need 140 degree water).
2. Keep the thermostat in your home under control. The recommended winter setting is 68 degrees in the daytime, 55 degrees at night. In summer, turn your air conditioner thermostat to 78 degrees.
3. When you leave a room turn off the light. Lighting accounts for 20% of all the electricity used in America and 10% of all the carbon dioxide released into the air, a major pollutant causing global warming.
4. Consider walking or biking once a week when you would normally drive. Besides saving energy and reducing pollution, it's good exercise and you will look great in that swimsuit next summer.

## Activity 2. Energy and the Environment

### Instruction Sheet

#### DO YOU KNOW. . .

- 💡 That by turning on the t.v. we are polluting the environment?
- 💡 How the use of energy is contributing to the Earth's increasing temperature?
- 💡 How much energy the typical person wastes everyday?



#### Saving Energy Good for the Environment

We often don't think about the effects of leaving on a light or the television after we leave a room. But if we all made a commitment to conserve energy the benefits to our planet would be immense. Consider these facts.

- ◆ If each U.S. household increased the energy efficiency of their major appliances by 10% to 30%, we would reduce the demand for electricity by the equivalent of 25 large power plants.
- ◆ Substituting a compact fluorescent light for a traditional bulb will reduce carbon dioxide releases into the air by about one half ton over the life of the bulb.
- ◆ If every American family planted just one tree, over a billion pounds of "greenhouse gases" that cause global warming and other pollution would be filtered from the atmosphere every year.

Saving energy is indeed saving the Earth. And Kentuckians have tremendous opportunities to reduce energy use and reduce environmental pollution, all while saving money. According to the Kentucky Division of Energy, an estimated 25% of the energy we use is wasted due to inefficiency and overconsumption.

*Students of the Meyzeek Middle School are doing their part to conserve our energy and natural resources. A student "Environmental Police Patrol" cites teachers who leave their lights on or toss white paper or aluminum cans in the trash. "I get zapped every once in while for leaving my lights on when I'm out of the room," lamented Deborah Baker, Meyzeek's principal. "I'm real good at recycling white paper but notorious for lights."* (Excerpted with permission from Green Kid Power, Kentucky School Students Convene Their Own Environmental Summit to Help Out the Adults, By Bob Deitel - Courier-Journal 5/18/93.)

The decade of the 1990s will be one of heightened energy conservation awareness and changing habits. Kentuckians must strive to become more energy efficient and to look realistically at opportunities to conserve our energy resources.

#### 💡 Purpose:

In this activity you will research the importance of energy conservation and how we can all play a part in lowering our energy costs while reducing environmental impacts associated with the production and use of energy.

#### 💡 Procedure:

##### Part I - Reviewing the Environmental Impacts of Energy Use

1. Obtain Worksheet #1 from your teacher. Review, discuss, and answer questions.

##### Part II - Researching Transportation and Its Contribution to Global Warming

1. Divide into three groups. Design and conduct a research project that accomplishes the following:

Group A - Research the amount of energy used for bus transportation to and from school. Find out the number of school buses that serve the school, the miles per gallon of gasoline the buses get, and the total miles driven each day. Calculate the gallons of gasoline consumed per day and per school year. Calculate the amount of carbon dioxide produced by all the buses if 20 pounds are released per gallon of gasoline consumed. Ask your school administrators if there are long-range plans for reducing fuel consumption by school buses by switching to alternative energy sources or other methods.

Group B - Research the amount of energy used by people who drive personal vehicles to school. To do this count all the vehicles in the parking lot on an average day. You can also attach a survey to each car windshield asking them to report the total number of miles driven to and from school.

Average the number of miles traveled per day based on your survey results or by estimating the average

## Instructions continued

miles students and teachers travel to and from school each day. Multiply the average amount of miles by the number of vehicles you counted earlier in the parking lot. Using 25 miles per gallon (m.p.g.) as the average fuel efficiency, calculate how much gasoline was consumed. Calculate the amount of carbon dioxide produced if 20 pounds are released per gallon of gasoline consumed.

Group C - Call or visit various new car dealers and ask for information about the fuel efficiency of the vehicles they sell, or research the information from a publication such as "Consumer Guide to New Cars." Calculate the amount of carbon dioxide that would be produced per vehicle if 20 pounds of carbon dioxide was released per gallon of gasoline consumed. Graph the results for each vehicle.

2. As a class, do a display for the school which shows your findings. Include in your display how much carbon dioxide releases could be reduced by those who drive to school if everyone who drove bought the most fuel efficient vehicles available or if we carpooled reducing the number of vehicles driven to school by half.

### Part III - Reducing Your Energy Use

1. Follow the lead of Lexington's Lafayette High School students who organized a school-wide campaign to encourage students and school personnel to reduce their energy consumption by 25%. Your class can start an energy awareness project to educate others about the pollution problems caused by burning fossil fuels. Develop pledge cards and organize a school seminar to discuss energy conservation needs and opportunities.

### Other Activities:

1. Conduct an energy audit of your school or home. Improving energy efficiency can save up to 40% of the cost of energy. Contact the Kentucky Division of Energy, 691 Teton Trail, Frankfort, KY 40601, 1-800-282-0868, for more information about how to conduct an audit and implement an energy audit.
2. Contact your electric utility to find out how they promote energy conservation.

### References/Additional Resources:

1. "30 Simple Energy Things You Can Do To Save the Earth," summarizes what we can do to change our impact on the environment by changing the way we use energy. Contact the Kentucky Division of Energy, 691 Teton Trail, Frankfort, KY 40601, 1-800-282-0868, for a free copy.
2. Teachers: "You Make a Difference, A Conservation Unit on Energy and the Environment," includes student activities correlated to the 75 KERA Learner Outcomes. Contact the Louisville Gas and Electric Company, Public Information Office, 220 West Main, Louisville, KY 40202, 502-627-3772.
3. "Energy Education Resources," is a listing of available resources for kindergarten through 12th grade. For a copy contact the National Energy Information Center, 202-586-8800.





## Activity 2. Energy and the Environment

### Worksheet #1

#### Steady Rise in Global Temperatures Attributed to the Burning of Fossil Fuels

Global warming is one of the most complex air quality problems facing the world today. The appearance of a slow, yet steady rise in the Earth's average temperature is now attributed to increasing levels of greenhouse gases (carbon dioxide, nitrogen oxides, and methane) in the atmosphere, and the depletion of the Earth's protective stratospheric ozone layer, according to most of the world's leading scientists.

Naturally occurring gases in the atmosphere absorb the heat reflected from the Earth. This process, called the "greenhouse effect," warms the Earth making it habitable. However, many human activities, especially the burning of fossil fuels such as petroleum and coal, and deforestation and other land use changes are rapidly increasing the amount of greenhouse gases in the atmosphere (Figure 1).

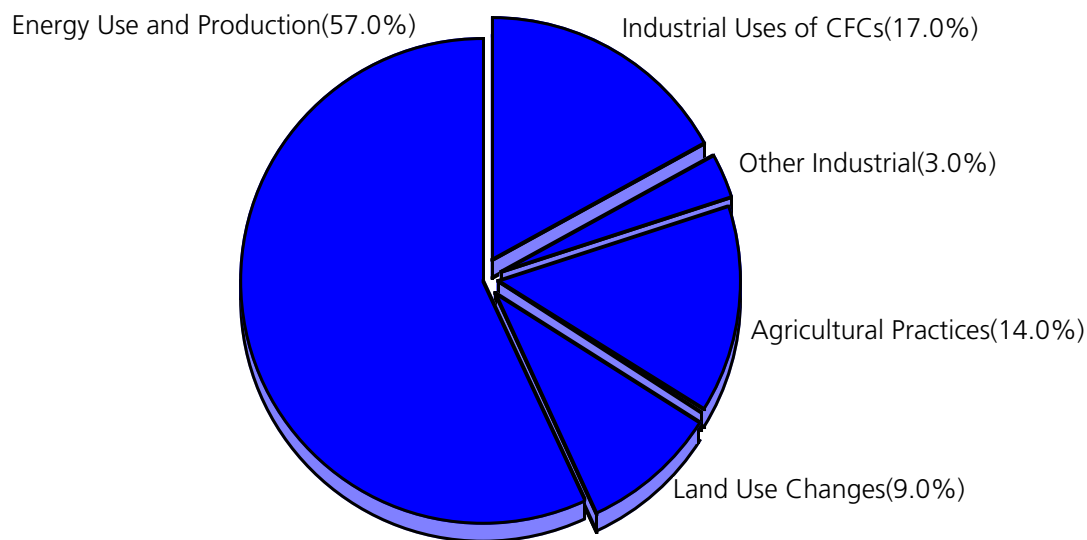
This increase, coupled with the depletion of the protective stratospheric ozone layer, is believed to be enhancing the greenhouse effect, causing average global temperatures to rise. The rising temperatures are predicted to have widespread impacts on climate, ocean levels, agricultural production, and water supplies during the next several decades and beyond.

Additional reductions in the release of some air pollutants are required by the federal Clean Air Act Amendments passed by Congress in 1990. These requirements are expected to help reduce the greenhouse gases linked to global warming.

However, many contend that much more needs to be done to address global warming. During June 1992, leaders from around the world came together for the United Nations "Conference on the Environment and Development" in Rio de Janeiro, Brazil. At the conference, known as the "Earth Summit," 157 governments signed a global climate change treaty to slow global warming. The treaty represents the first large scale effort to address global environmental problems.

Figure 1

#### Sources Contributing to Global Warming



Source: U.S. EPA and IPCC Scientific Assessment, 1991



## Worksheet #1 continued

### Acid Rain Linked To Use of Energy

Another environmental problem associated with energy use is "acid rain." Acid rain is linked to sulfur dioxide and nitrogen oxide released during the burning of fossil fuels, especially coal and petroleum.

Sulfur and nitrogen pollutants released from the burning of coal by power plants in the Ohio River Valley are carried far upwind where they chemically react with water to form acid rain. Acid rain is causing problems in lakes and forests in the Northeastern U.S. and Canada.

The pH or acidity of Kentucky's rainfall is 4.7 - well below the normal pH 5.5. Although rainfall in Kentucky is acidic, it has not noticeably impacted the state's water or forest resources due to the naturally alkaline soils found here which neutralize the acidity.

The federal Clean Air Act Amendments passed by Congress in 1990 will require significant national reductions in sulfur dioxide releases during the next five years, and further reductions by the year 2000.

Most of these reductions will be made at power plants since these facilities are responsible for 85-90% of the sulfur dioxide released into the air. Seventeen of the state's 58 coal-fired power plant units have installed scrubbers to control these emissions. Scrubbers remove a great deal of these pollutants before they are released from a smokestack. Another ten power plant units in the state will be required to reduce sulfur dioxide releases by 1995 and an even greater number will be affected before the year 2000 (Figure 2).

### QUESTIONS?

1. What are some of the environmental problems associated with the use of energy?
2. What impact do you think global warming will have on Kentucky should the earth's temperature continue to rise as predicted?
3. Obtain the daily average temperatures for Kentucky for the following years: 1950, 1960, 1970, 1980, 1990. The local library can tell you how to get this information. Plot the averages on a chart. Do you see any indications that global warming is occurring in Kentucky? Explain your answer.

Figure 2

### Sulfur Dioxide Releases into the Air (tons) from Kentucky Coal-Burning Power Plants

County	Facility	1976	1990
McCracken	TVA-Shawnee	288,000	47,000
Muhlenburg	Kentucky Utilities-Green River	27,000	16,000
Muhlenburg	TVA-Paradise	456,000	137,000
Ohio	Big Rivers Electric-Wilson	0	8,552
Daviess	OMU Elmer Smith	74,000	51,000
Hancock	Big Rivers Electric-Coleman	100,000	71,000
Henderson	Henderson Mun. Power & Light	9,000	1,000
Webster	Big Rivers Electric-Reid	81,000	49,000
Webster	Big Rivers Electric-Green	0	11,000
Boone	Cincinnati Gas & Electric	0	20,000
Carroll	Kentucky Utilities-Ghent	76,000	101,000
Bell	Kentucky Utilities-Pineville	1,000	300
Clark	E. Ky. Rural Electric-Dale	8,000	3,000
Fayette	Kentucky Utilities*	5	5
Mercer	Kentucky Utilities-Brown Station	57,000	56,000
Woodford	Kentucky Utilities-Tyrone	2,000	1,000
Lawrence	Ky. Power-Big Sandy	60,000	51,000
Mason	E. KY. Power Co.-Spurlock	0	31,000
Pulaski	E. KY. Power Co.-Cooper	35,000	18,000
Jefferson	LG&E-Mill Creek	112,039	26,625
Jefferson	LG&E-Cane Run	109,578	12,163
<b>Statewide</b>		<b>1,496,417</b>	<b>713,388</b>

Note: Figures shown may not equal totals because they were rounded to the nearest ton.

\*Not coal-fired.

Source: Kentucky Division for Air Quality and Jefferson County Air Pollution Control District 1992

## Worksheet #1 continued

5. What percent reduction occurred in the total sulfur dioxide releases from all the power plants in Kentucky listed in Figure 2 between the years 1976 and 1990?
6. Which power plant in Figure 5 supplies your electricity? What percent did this plant reduce sulfur dioxide releases between 1976 and 1990? How does this compare with the total reductions calculated in question #5?

### WHAT YOU CAN DO...

1. Automobiles account for more than 20% of the carbon dioxide released into our air, 34% of our acid rain-causing nitrogen oxides, and 27% of our smog-related hydrocarbons. The impact of the automobile is too great to ignore. When you shop for a car, find out what its gas mileage is. If you're buying a used car, ask the previous owner for his or her gas mileage records.
2. Keep your car tuned up. A well-tuned car uses up to 9% less gasoline than a poorly tuned car.
3. Carpool, walk, or ride a bike whenever possible.



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